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Dividends from Wood Research

Recent Publications

July–December 2005

Explanation and Instructions

"Dividends from Wood Research" is a semiannual listing of recent publications resulting from wood utilization research at the Forest Products Laboratory (FPL). These publications are produced to encourage and facilitate application of Forest Service research. This issue lists publications received between July 1 and December 31, 2005.

Each publication listed in this brochure is available through at least one of the following sources.

Available from FPL (indicated by an order number before the title of the publication): Quantities limited. Circle the order number on the blank at the end of the brochure and mail or fax the blank to FPL.

Available through the Internet: Listed publications are available as PDF documents for viewing or printing from FPL's web site (www.fpl.fs.fed.us).

Available through sales outlets: Major sales outlets are the Superintendent of Documents, the National Technical Information Service (NTIS), and various private publishers. Order directly from the outlet.

Available through libraries: Research publications are available through many public and university libraries in the United States and elsewhere. U.S. Government publications are also available through many Government Depository Libraries. Check with a major library near you to determine availability.

List of Categories

Publications are listed in this brochure within the following general categories:

- Biodiversity and Biosystematics of Fungi
- Decay Processes and Bioprocessing
- Durability
- General
- Papermaking and Paper Recycling
- Properties and Use of Wood, Composites, and Fiber Products
- Recycling of Wood Products
- Surface Chemistry
- Timber and Fiber Demand and Technology Assessment
- Wood Chemistry

Biodiversity and Biosystematics of Fungi

Identification and First Report on *Inonotus (*Phellinus) *tropicalis* as an Etiologic Agent in a Patient with Chronic Granulomatous Disease

Sutton, D.A.; Thompson, E.H.; Rinaldi, M.G.; Iwen, P.C.; Nakasone, K.K.; Jung, H.S.; Rosenblatt, H.M.; Paul, E.E.
2005. J. Clin. Microbiol. 43(2): 982–987.
www.fpl.fs.fed.us/documnts/pdf2005/fpl_2005_sutton001.pdf

Decay Processes and Bioprocessing

Enzymology and Molecular Biology of Lignin Degradation

Cullen, D.; Kersten, P.J.
2004. In: R. Brambl and G.A. Marzluf, eds. The Mycota III. Biochemistry and Molecular Biology, 2nd Edition. Berlin-Heidelberg: Springer-Verlag: 13: 249–273.
www.fpl.fs.fed.us/documnts/pdf2004/fpl_2004_cullen002.pdf

Copper Tolerance of Brown-Rot Fungi: Oxalic Acid Production in Southern Pine Treated with Arsenic-Free Preservatives

Green, Frederick III; Clausen, Carol A.
2005. Int. Biodeter. & Biodegrad. 56(2005): 75–79.
www.fpl.fs.fed.us/documnts/pdf2005/fpl_2005_green002.pdf

Durability

► **1. Condition Assessment of Timber Bridges: 2. Evaluation of Several Stress-Wave Tools**

Brashaw, Brian K.; Vatalaro, Robert J.; Wacker, James
2005. Gen. Tech. Rep. FPL–GTR–160. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 11 p.
www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr160.pdf

This study was conducted to evaluate the accuracy and reliability of several stress-wave devices widely used for locating deteriorated areas in timber bridge members. Bridge components containing different levels of natural decay were tested using various devices. The specimens were then sawn (along their length) into slabs to expose their interior condition. The interior faces of these slabs were inspected visually and with a resistance micro-drill to confirm

if deterioration was present. On the basis of these tests, we conclude that all four devices evaluated in this study can successfully be used to evaluate decay. There were, however, differences in the decay thresholds and user-friendliness among the devices.

► **2. Durability of Structural Lumber Products after Exposure at 82°C and 80% Relative Humidity**

Green, David W.; Evans, James W.; Hatfield, Cherilyn A.; Byrd, Pamela J. 2005. Research Paper FPL–RP–631. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 20 p.
http://www.fpl.fs.fed.us/documnts/fplrp/fpl_rp631.pdf

Solid-sawn lumber (Douglas-fir, southern pine, Spruce–Pine–Fir, and yellow-poplar), laminated veneer lumber (Douglas-fir, southern pine, and yellow-poplar), and laminated strand lumber (aspen and yellow-poplar) were heated continuously at 82°C (180°F) and 80% relative humidity (RH) for periods of up to 24 months. The lumber was then reconditioned to room temperature at 205% RH and tested in edgewise bending. Little reduction occurred in modulus of elasticity (MOE) of solid-sawn lumber, but MOE of composite lumber products was somewhat reduced. Modulus of rupture (MOR) of solid-sawn lumber was reduced by up to 50% after 24 months exposure. Reductions in MOR of up to 61% were found for laminated veneer lumber and laminated strand lumber after 12 months exposure. A limited scope study indicated that the results for laminated veneer lumber in edgewise bending are also applicable to flatwise bending. Comparison with previous results at 82°C (180°F)/25% RH and at 66°C (150°F)/20% RH indicate that differences in the permanent effect of temperature on MOR between species of solid-sawn lumber and between solid-sawn lumber and composite lumber products are greater at high humidity levels than at low humidity levels. This report also describes the experimental design of a program to evaluate the permanent effect of temperature on flexural properties of structural lumber, with reference to previous publications on the immediate effect of temperature and the effect of moisture content on lumber properties.

► **3. Treatability of Underutilized Northeastern Species with CCA and Alternative Wood Preservatives**

Lebow, Stan T.; Halverson, Steven A.; Hatfield, Cherilyn A. 2005. Research Note FPL–RN–0300. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 5 p.
www.fpl.fs.fed.us/documnts/fplrn/fpl_rn300.pdf

Opportunities for use of northeastern species such as balsam fir, eastern spruce, eastern hemlock, and red maple could be improved if these species could be adequately penetrated with preservatives and subsequently shown to be durable in outdoor exposures. In this study, specimens cut from lumber of northeastern species were pressure-treated with either chromated copper arsenate type C (CCA-C), ammoniacal copper citrate (CC), alkaline copper quat type C (ACQ-C), or copper azole type A (CBA-A). Treatability was assessed by measuring retention and penetration of preservative. The results indicate that the arsenic- and chromium-free alternatives to CCA-C can treat northeastern species at least as well as CCA-C and may offer treatability advantages over CCA-C in species such as eastern hemlock and balsam fir. Two species, red maple and eastern spruce, were not adequately treated with any preservative, even after incising. Above-ground and ground-contact durability evaluations with these preservative–wood species combinations are in progress.

► **4. Heat Sterilization Times of Five Hardwood Species**

Simpson, William; Wang, Xiping; Forsman, John; Erickson, John.
2005. Res. Pap. FPL–RP–626. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 10 p.
www.fpl.fs.fed.us/documnts/fplrp/fpl_rp626.pdf

Heat sterilization of lumber, timbers, and pallets is currently used to kill insects, thus preventing their transfer between countries in international trade. An important factor in this treatment is the time required for the center of any wood configuration to reach the temperature necessary to kill the insect. This study explored the effect of size (1-, 1.5-, and 2.0-in.-thick by 6-in.-wide boards, and 3- by 3-, 4- by 4-, and 6- by 6-in. timbers), hardwood species (red maple, sugar maple, red oak, basswood, and aspen), and two wet-bulb depressions (nominal 2°F and 8–10°F) at a nominal heating temperature of 160°F. Two analytical methods were examined for their ability to calculate estimated heating times. Heating times varied from about 15 min for 1- by 6-in. boards to 300 min for 6- by 6-in. timbers. Heating time was about 15% longer at the larger of the two wet-bulb depressions. Some species differences were significantly different statistically but were not different enough in practical terms to warrant heating separately. We found that the wet-bulb temperature could be used successfully in an analytical model as the heating temperature when evaporation of water cooled the surface below the nominal heating temperature.

Pennsylvania Hardwood Timber Bridges: Field Performance after 10 Years

Wacker, James P.; Calil, Carlito Jr.
2004. In: Proceedings of the Structural Materials Technology VI, An NDT Conference, 14–17 September 2004. Buffalo, New York, USA. American Society for Nondestructive Testing: 222–227.
www.fpl.fs.fed.us/documnts/pdf2004/fpl_2004_wacker002.pdf

General

► **5. The Decline and Fall of Type II Error Rates**

Verrill, Steve; Durst, Mark
2005. Research Paper FPL–RP–628. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 11 p.
www.fpl.fs.fed.us/documnts/fplrp/fpl_rp628.pdf

For general linear models with normally distributed random errors, the probability of a Type II error decreases exponentially as a function of sample size. This potentially rapid decline reemphasizes the importance of performing power calculations.

Nanotechnology for Forest Products, Part 2

Wegner, Theodore; Jones, Phil
2005. Solutions! for People, Processes and Paper Technology Summit II. 43–45.
www.fpl.fs.fed.us/documnts/pdf2005/fpl_2005_wegner001.pdf

Papermaking and Paper Recycling

Processing of Fibre Suspensions at Ultra-High Consistencies

Caulfield, Daniel F.; Jacobson, Rodney E.
2004. In: The 2004 Progress in Paper Physics Seminar, June 21–24, 2004, NTNU and FPI, Trondheim, Norway, TAPPI Paper Physics Committee, Papir-og fiber institutter AS and Paper and Fibre Research Institute: p. 104.
www.fpl.fs.fed.us/documnts/pdf2004/fpl_2004_caulfield001.pdf

Semiannual Patents Review: July–December 2003

Gleisner, Roland; Scallon, Karen; Tan, Freya; Blankenburg, Julie; Sykes, Marguerite
2004. Progress in Pap. Recycl. 13(3): 34–42.
www.fpl.fs.fed.us/documnts/pdf2004/fpl_2004_gleisner001.pdf

Laccase Modification of the Physical Properties of Bark and Pulp of Loblolly Pine and Spruce Pulp

Kenealy, William; Klungness, John; Tshabalala, Mandla; Horn, Eric; Akhtar, Masood; Gleisner, Roland; Buschle-Diller, Gisela
2004. In: Saha, B.C.; Hayashi, K., eds. ACS Symposium Series 889; Lignocellulose biodegradation. Washington, D.C.: American Chemical Society: Chapter 7: 126–138.
www.fpl.fs.fed.us/documnts/pdf2004/fpl_2004_kenealy002.pdf

Light-Induced Yellowing of Selectively ^{13}C-Enriched Dehydrogentation Polymers (DHPs). Part 1. Side-Chain ^{13}C-Enriched DHP (α, β, and γ–^{13}C)

Parkås, Jim; Paulsson, Magnus; Terashima, Noritsugu; Ralph, Sally
2004. Nord. Pulp & Pap. Re. J. 19(1): 29–36.
www.fpl.fs.fed.us/documnts/pdf2004/fpl_2004_parkas001.pdf

Light-Induced Yellowing of Selectively ^{13}C-Enriched Dehydrogentation Polymers (DHPs). Part 2. NMR Assignments and Photoyellowing of Aromatic Ring 1-, 3-, 4-, and 5-^{13}C DHPs

Parkås, Jim; Paulsson, Magnus; Terashima, Noritsugu; Ralph, Sally
2004. Nord. Pulp & Pap. Re. J. 19(1): 44–52.
www.fpl.fs.fed.us/documnts/pdf2004/fpl_2004_parkas002.pdf

Some Recent Developments in Headspace Gas Chromatography

Zhu, J.Y.; Chair, X.-S.
2005. Current Analytical Chemistry 1: 79–83.
www.fpl.fs.fed.us/documnts/pdf2005/fpl_2005_zhu002.pdf

Drainage and Fractionation of Wood Fibers in a Flotation Froth

Zhu, J.Y.; Tan, Freya
2005. Progress in Pap. Recycl. 14(4): 13–20.
www.fpl.fs.fed.us/documnts/pdf2005/fpl_2005_zhu004.pdf

Dynamic Drainage of Froth with Wood Fibers

Zhu, J.Y.; Tan, Freya
2005. Ind. Eng. Chem. Res. 44: 3336–3342.
www.fpl.fs.fed.us/documnts/pdf2005/fpl_2005_zhu003.pdf

Monitoring Liquid and Solid Content in Froth Using Conductivity

Zhu, J.Y., Tan, F., Gleisner, R.
2005. Progress in Pap. Recycl. 14(4): 21–29.
www.fpl.fs.fed.us/documnts/pdf2005/fpl_2005_zhu005.pdf

On Fiber Rejection Loss in Flotation Deinking

Zhu, J.Y., Tan, Freya
2005. Can. J. Chem. Eng. 83 (April 2005): 377–382.
www.fpl.fs.fed.us/documnts/pdf2005/fpl_2005_zhu006.pdf

Properties and Use of Wood, Composites, and Fiber Products

Structural Lumber from Dense Stands of Small-Diameter Douglas-fir Trees

Green, David W.; Lowell, Eini C.; Hernandez, Roland
2005. Forest Prod. J. 55(7/8): 42–50.
www.fpl.fs.fed.us/documnts/pdf2005/fpl_2005_green001.pdf

Two Dimensional Finite Element Heat Transfer Models for Softwood

Gu, Hongmei; Hunt, John F.
2004. In: Proceedings: 7th Pacific Rim Bio-Based Composites Symposium, Nanjing, China, October 31–November 2, 2004, Volume 1. Nanjing Forestry University: Science & Technique Literature Press: 344–353.
www.fpl.fs.fed.us/documnts/pdf2004/fpl_2004_gu001.pdf

Evaluation of a Reduced Section Modulus Model for Determining Effects of Incising on Bending Strength and Stiffness of Structural Lumber

Hernandez, Roland; Winandy, Jerrold E.
2005. Forest Prod. J. 55(9): 77–83.
www.fpl.fs.fed.us/documnts/pdf2005/fpl_2005_hernandez001.pdf

Finite Element Analyses of Wood Laminated Composite Poles

Piao, Cheng; Shupe, Todd F.; Tang, R.C.; Hse, Chung Y.
2005. Wood Fiber Sci. 37(3): 535–541.
www.fpl.fs.fed.us/documnts/pdf2005/fpl_2005_piao001.pdf

Hardwoods for Timber Bridges: A National Program Emphasis by the USDA Forest Service

Wacker, James P.; Cesa, Ed
2005. Wood Design Focus 15(2), Summer 2005: 7–10.
www.fpl.fs.fed.us/documnts/pdf2005/fpl_2005_wacker001.pdf

► **6. Designated Fiber Stress for Wood Poles**

Wolfe, Ronald W.; Kluge, Robert O.
2005. Gen. Tech. Rep. FPL–GTR–158. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 39 p.
www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr158.pdf

Wood poles have been used to support utility distribution lines for well over 100 years. Over that time, specifications for a "wood utility pole" have evolved from the closest available tree stem more than 15 ft in length to straight, durable timbers of lengths ranging up 125 ft and base diameters of as much as 27 in. The

continued success of wood poles in this application is due in part to the development of consensus standards. These standards define the phrase "minimum acceptable" to the satisfaction of both users and producers. They also encourage more competitive pricing by relaxing species as well as quality limitations, opening the market to a broader range of available timber resources. The American National Standards Institute (ANSI) standard ANSI O5.1 is an internationally recognized standard that has served as a guide for selecting the quality and size of wood utility poles for more than 70 years. From its inception, this standard has addressed issues of relative load capacity as well as physical quality to allow for species substitutions. In 2002, the relative strength evaluations previously published as a designated fiber stress took on added meaning when they were defined to represent the mean of the distribution of pole groundline strength values for various species. The change in meaning was accompanied by a more rigorous evaluation recognizing a change in strength with height and notation that pole strength distributions have a coefficient of variation of 20%. This paper reviews the history and philosophy of the ANSI designated fiber stress to help the reader more fully understand and appreciate the significance of changes adopted by the American Standards Committee O5 (ASC O5) in 2002.

Tensile and Dimensional Properties of Wood Strands Made from Plantation Southern Pine Lumber

Wu, Qinglin; Cai, Zhiyong; Lee, Jong N.
2005. Forest Prod. J. 55(2): 87–92.
www.fpl.fs.fed.us/documnts/pdf2005/fpl_2005_wu001.pdf

Low Frequency Vibration Approach for Assessing Performance of Wood Floor Systems

Wang, Xiping; Ross, Robert J.; Hunt, Michael O.; Erickson, John R.
2005. Wood Fiber Sci. 37(3): 371–378.
www.fpl.fs.fed.us/documnts/pdf2005/fpl_2005_wang001.pdf

Recycling of Wood Products

Remilling of Salvaged Wood Siding Coated with Lead-Based Paint, Part 1. Lead Exposure

Falk, Robert H.; Janowiak, Cosper, Stephen D.; Drozdz, Susan A.
2005. Forest Prod. J. 55(78): 76–80.
www.fpl.fs.fed.us/documnts/pdf2005/fpl_2005_falk001.pdf

Remilling of Salvaged Wood Siding Coated With Lead-Based Paint, Part 2. Wood Product Yield

Janowiak, John J.; Falk, Robert H.; Beakler, Brian W.; Lampo, Richard G.; Napier, Thomas R.
2005. Forest Prod. J. 55(7/8): 81–86.
www.fpl.fs.fed.us/documnts/pdf2005/fpl_2005_janowiak001.pdf

Surface Chemistry

The Challenge of Bonding Treated Wood

Frihart, Charles R.
2004. In: Fernanado Fernando Caldeira Jorge, Ed. Proceedings of ICECFOP1—1st International Conference on Environmentally-Compatible Forest Products, Fernando Pessoa University, Oporto, Portugal, 22–24 September, 2004: 351–356.
www.fpl.fs.fed.us/documnts/pdf2004/fpl_2004_frihart002.pdf

Specific Adhesion Model for Bonding Hot-Melt Polyamides to Vinyl

Frihart, Charles R.
2004. Int. J. Adhesion & Adhesives 24: 415–422.
www.fpl.fs.fed.us/documnts/pdf2004/fpl_2004_frihart001.pdf

Improved Water Resistance of Bio-Based Adhesives for Wood Bonding

Frihart, Charles R.; Wescott, James M.
2004. In: Fernando Caldeira Jorge, Ed. Proceedings of ICECFOP1—1st International Conference on Environmentally-Compatible Forest Products, Fernando Pessoa University, Oporto, Portugal, 22–24 September, 2004: 293–302.
www.fpl.fs.fed.us/documnts/pdf2004/fpl_2004_frihart003.pdf

Timber and Fiber Demand and Technology Assessment

► **7. Fuel to Burn: Economics of Converting Forest Thinnings to Energy Using Biomax in Southern Oregon**

Bilek, E.M. (Ted); Skog, Kenneth E.; Fried, Jeremy; Christensen, Glenn
2005. Gen. Tech. Rep. FPL–GTR–157. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 27 p.
www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr157.pdf

Small-scale gasification plants that generate electrical energy from forest health thinnings may have the potential to deliver substantial amounts of electricity to the national grid. We evaluated the economic feasibility of two sizes of BioMax, a generator manufactured by the Community Power Corporation of Littleton, Colorado. At current avoided-cost electricity prices in Oregon, it would not be economical to operate a small-scale (100-kW) BioMax without a subsidy or tax credit, even if fuel were delivered to the plant at a forest landing at no cost. Given a tax credit, a 1,000-kW system could be operated profitably. If it were possible to sell merchantable logs (removed as part of forest health treatments) for an average of $175/thousand board feet, most acres on gentle slopes in southern Oregon would provide net operating surpluses. Most steeply sloped acres would generate operating deficits. If merchantable timber were sold separately, biomass from forest health thinnings on timberland in 15 western states could potentially provide from 2.3 to 14.3 billion kWh of electricity to the national grid. Our results suggest that if a forest landing is located near an existing power line, distributed energy generation is an option that may be worth considering.

U.S. Forest Products Annual Market Review and Prospects, 2001–2005

Howard, James L.
2005. Research Note FPL–RN–0299. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 11 p.
www.fpl.fs.fed.us/documnts/fplrn/fpl_rn299.pdf

This report provides general and statistical information on forest

products markets in terms of production, trade, consumption, and prices. The current state of the United States economy is described. Market developments are described for sawn softwood, sawn hardwood, softwood log trade, wood-based panels, paper and paperboard, fuelwood, and forest products prices. Policy initiatives that can impact domestic markets and international trade in wood products are also discussed in some detail. Projections for the year 2005 are also presented.

Hampton Mill Maintains Title: Top Twelve Producer Mills Are in Northwest

Spelter, Henry
2004. Timber Processing, July/August 2004: 67.
www.fpl.fs.fed.us/documnts/pdf2004/fpl_2004_spelter002.pdf

► **8. Profile 2005: Softwood Sawmills in the United States and Canada**

Spelter, Henry
2005. Research Paper FPL–RP–630. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 85 p.
www.fpl.fs.fed.us/documnts/fplrp/fpl_rp630.pdf

The softwood lumber industry in the United States and Canada consists of about 1,068 sawmills. In 2005 these sawmills had a combined capacity of 189 million m^3 (79.9×10^9 board feet) and employed about 99,000 people. In 2004 they produced 172 million m^3 (nominal) (73.0×10^9 board feet) of lumber and, in the process, consumed about 280 million m^3 (9.9×10^9 ft^3) of timber. Employee productivity was near 2,125 m^3 (900,000 board feet) per worker per year for dimension and stud mills but about half that for board, timber, and specialty mills. Average saw log size varied from 48 cm (19 in.) in British Columbia to 15 cm (6 in.) in the boreal region of eastern Canada. Average lumber recovery factors varied from 274 board feet per cubic meter (7.75 board feet per cubic foot) for timber mills to 234 (6.6 board feet per cubic foot) for specialty mills. The average for dimension mills was 266 (7.5 board feet per cubic foot). Strong underlying demand for housing, supported by demographic growth among young adults, and by generational low interest rates are strong positives for the industry's prospects. Low interest rates, however, are threatened by rising inflation, the measurement of which depends on whether new home prices are included or not.

► **9. Review of Alternative Measures of Softwood Sawtimber Prices in the United States**

Spelter, Henry
2005. Research Paper FPL-RP-629. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 16 p.
www.fpl.fs.fed.us/documnts/fplrp/fpl_rp629.pdf

This study compares prices from various timber market reports and an estimate of timber value derived from product-selling prices and manufacturing costs. In the South, two primary sources of timber price information are Forest2Market (F2M) and Timber Mart-South (TMS). Comparisons showed that F2M prices are generally higher than TMS prices for both stumpage and delivered timber. Residual value (RV) estimates tended to vary from these at any given time. Over 5 years, however, the negative and positive deviations largely offset each other, resulting in roughly the same average price levels, at least compared with TMS. The RV estimates also tended to lead the direction of reported prices and were useful as leading indicators of reported market price directions.

Comparison of various price reports from public and private agencies in the West showed that Forest Service prices were substantially lower than those recorded by other agencies and RV calculations. The discounts appear to reflect lower quality offerings and more restrictive harvest regulations that increase harvest costs.

This report proposes a method of pricing timber based on RV calculations as one means to reduce the variability in lumber sawmilling profits.

Wood Chemistry

► **10. Time- and Cost-Saving Apparatus for Analytical Sample Filtration**

Kenealy, William R.; Destree, Joseph C.
2005. Research Note FPL–RN–0298. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 2 p.
www.fpl.fs.fed.us/documnts/fplrn/fpl_rn298.pdf

Simple and cost-effective protocols were developed for removing particulates from samples prior to analysis by high performance liquid chromatography and gas chromatography. A filter and vial holder were developed for use with a 96-well filtration plate. The device saves preparation time and costs.

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